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The Role of Hydrology in the Resolution of Water Disputes

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Hydrology is irrelevant to adjudication. This is a statement any western water lawyer might make. Most western states, on paper, rely on the doctrine of prior appropriation to allocate this resource with its variable supply (Hutchins 1971). Thus in times of drought, rather than re-allocate the supply to share shortage, use is eliminated in order of reverse priority. Those first to the stream take a full supply; those last go without. Adjudication need only sort out the various priorities; the ditch rider will do the rest.

But consider a layperson's translation of the statement "hydrology is irrelevant to adjudication" – i.e. understanding the water resource is irrelevant to its allocation. To anyone but the most reverent adherent to prior appropriation as the panacea, this is absurd. Historically we have built dams rather than face the harsh consequences of shutting off junior water uses. In modern times, we buy senior water rights to serve more economically or politically successful junior needs. In rare instances we rely on allocation through prior appropriation. In all three cases, understanding the water resource is essential.

Adjudication does not exist in a vacuum. It is not an end in itself, but rather a means of defining the legal basis on which future water allocation decisions will be made. Management and enforcement of water rights in a complex system can only occur against the backdrop of a useable database defining and relating the many rights within it. A water transfer cannot occur without a complete definition of the right being transferred. This means not only a definition of priority, use and quantity – elements commonly defined in adjudication — but because transfer can only occur in prior appropriation states with no injury to other water uses (e.g. Idaho Code §42-222(1)), an understanding of the effects of altering diversion and return flow is required. Design of physical solutions to mitigate the harsh impacts of prior appropriation requires an analysis of the impacts of the proposed solution on the many water rights. Even strict enforcement of prior appropriation may require sophisticated knowledge of the water resource in complex systems involving rights from surface and ground water sources that are hydrologically connected. Because these decisions can only be made with an understanding of the water resource, adjudication should not proceed without laying the groundwork for that understanding.

The advent of high speed computing has given us access to means to handle mathematically described relations between the complex variables that comprise and affect a water resource, and thus provides a tool for understanding the interplay between the resource and water use. This paper will discuss the importance of development and use of this tool – the hydrologic model – in adjudication and subsequent water management. Because hydrologic modeling can be misused due to the black-box nature of the tool from the viewpoint of the non-scientist, this paper will begin with background on development of models and stress the steps in which water managers, lawyers and policymakers must play a role to assure that the model developed will serve the purpose they intend. The paper will then describe the compilation of data and development of a hydrologic surface water model for use in adjudication, settlement and water management in the Milk River, Montana, followed by discussion of development of a hydrologic ground water model for enforcement and conjunctive management of ground and surface water in the Eastern Snake River Basin, Idaho. The author of this paper is not a hydrologist, thus the viewpoint is that of the lawyer/mediator/participant in water disputes author of this paper is not a hydrologist, thus the viewpoint is that of the lawyer/mediator/participant in water disputes.

Hydrology and Dispute Resolution: Background

Let's begin with a few terms. A model is simply a representation of a real system (Anderson and Woessner 1992). The model may be a system of tanks and pumps that simulate water flow such as the Bay Model, a 1.5 acre model run by the U.S. Army Corps of Engineers which illustrates the function of the San Francisco Bay and Delta (Information on the Bay Model can be found at http://www.baymodel.org). Or, as discussed here, it may be a mathematical representation of the real system.

The names you see, those written in all caps – MODFLOW, HYDROSS – do not refer to hydrologic models but to computer code. Algorithms in Fortran used to relate data and variables on the water resource (Anderson and Woessner 1992). It is only when applied to a particular basin and developed using basin-specific data that code is transformed into a model for that basin. Thus, because a MODFLOW model proved highly reliable and useful in one water basin, does not mean it is in another.

Anderson and Woessner (1992) describe the twelve steps in development of a hydrologic model. It is in the first two steps, defining the purpose and developing the conceptual model, that input from water managers, lawyers involved in the water dispute, and policymakers is crucial. The first step in developing a hydrologic model is to define the purpose of the model. Four things must be discussed among modelers and decision-makers at this stage: (1) purpose, (2) scale, (3) timeline, and (4) funding. The purpose or use for the model determines the type of model that must be developed, or whether a model is even the most appropriate tool for the intended purpose (Anderson and Woessner, 1992). A non-scientist guide to types of models may help with understanding the importance of this step.

A hydrologic model, whether for surface or ground water, may be a "lumped parameter model" or a "distributive parameter model" (Matthews et al. 2001). A lumped parameter model uses uniform values for input including precipitation, infiltration and topography, (Matthews et al. 2001), or in the case of a ground water model, input such as permeability, throughout the basin. Although a water basin of such homogeneity is not likely to exist in reality, the approach is useful if a simple comparison of water supply solutions, such as the addition or elimination of a reservoir, are being made and time or data are in short supply. However, if a water management tool is sought to analyze specific changes in water use or management, a distributive parameter model that takes into account the heterogeneity of the basin is necessary (Matthews et al. 2001).

In addition to these choices, a model may be primarily a surface water model with ground water either ignored or accounted for only as a sink or source of contribution to surface flow. In contrast, a model may be primarily a ground water model, with surface water either ignored or again accounted for as a source or sink. Finally, with additional data, time and money, the two may be combined.

The reason for the separation between surface and ground water models is in part because the variables controlling water flow above and beneath the ground surface are distinctly different. However, it is in part artificial. It may come as a surprise to lawyers who take considerable ribbing from scientists for the artificial separation of surface and ground water in the law to learn that the law is not the only area in which this connection has been ignored. Until the recent advent of water resources programs, traditional university programs treated surface water modeling in courses for civil engineers and ground water modeling in courses for hydrogeologists – engineering and geology, two entirely separate departments and degrees on most university campuses. Thus, the background of the modeler is relevant to the purpose of the model.

To assist the modeler in choosing the most useful approach, decision-makers should communicate the questions they seek to answer. Is this a general analysis of water supply, or a management tool requiring detailed understanding of water use on a daily or weekly basis? Definition of purpose must take place in a dialog between decision-makers and modelers to guarantee useful results. For example, whether a ground water model, surface water model, or both are needed depends not only on the questions decision-makers seek to ask, but on the hydrologic importance of surface and ground water in the basin. In addition, some questions that decision makers ask simply cannot be answered with a model. One reason for this may be the problem of scale.

Scale is used here to refer to both the detail at which decision makers seek answers to questions in time and geographic terms (modelers will call this temporal and spatial scale respectively), and the corresponding detail at which data are available (see Matthews et al. 2001). For example, if flow and diversion records have historically been recorded on an average annual basis, a model addressing questions about daily management cannot be developed with any degree of accuracy. Nevertheless, if detailed analysis is sought despite a paucity of data, the question comes down to one of time and money. The modelers present at this initial meeting should spell out how much time and funding are needed to collect data at the level of detail necessary to respond to the questions asked. In water basins with seasonal and annual fluctuation in water supply and use, developing a representative record may take years. However, such investment may be warranted if the ultimate goal is development of a tool for management and enforcement. Since many adjudications take multiple decades, investment up front may provide the necessary tool to implement the decree once issued.

The next step is development of the conceptual model. This is the stage at which modelers attempt to define the physical parameters of the system and to review the available data (Anderson and Woessner 1992). It may not be until this stage that the modelers can answer the question of scale posed in Step 1. This step should include a field visit to the basin jointly by modelers and water managers. Viewing field data through the window of experiential information from managers may enhance understanding of the system. For example, if a water source is managed in priority, on what scale are decisions made – i.e. are diversions altered on a daily basis or normalized over a longer period such as two weeks?

Development of the conceptual model includes assembly of a database on water supply and use. Even in water basins with substantial data on water supply, detail is generally lacking on water use due to lack of metering and recording of diversion and return flows. The development of a database on water use based on a Geographic Information System (GIS) can solve the paucity of detailed data by allowing accurate calculation of area irrigated in any year and calculation of consumptive use based on crop type (Greiman 2005, Matthews et al. 2001, Xu et al. 2001). In the context of an adjudication, the GIS database can provide: (1) a graphic display of model output readily utilized by water managers and ditch riders in its implementation; (2) a powerful tool for analyzing historic information on water use; and (3) a more accurate recording of the elements of a decree than the current abstract format. In addition, the GIS database can provide a detailed input to a model on water use at the scale necessary for development of a tool that can be used in management and enforcement following adjudication.

Hydrology and Dispute Resolution: Case Studies

The following sections discuss the development and potential use of a GIS database for the Milk River, Montana; the development of a surface water model for settlement of tribal water rights on the Milk River, Montana; and the development of a ground water model for management and enforcement in the Eastern Snake River Plain, Idaho. None of these examples pertain to model developments within an adjudication. However, each illustrates ways in which the development of a database and model could enhance the product of adjudication and its subsequent implementation.

Database Development for the Milk River, Montana

The Milk River in north-central Montana is a prairie stream in the bed of the ancestral Missouri River. Thousands of years ago, ice pushed the Missouri River south into its present channel in Montana, leaving an empty river bed and a vast plain of glacial debris. A small stream that swells to a river in spring with runoff from the Rocky Mountain Front, began to carve its own path in the wake of the ancestral Missouri (Swenson 1957). Because of its load of suspended glacial silt, Meriwether Lewis called this stream the "Milk River" (DeVoto 1953). With its headwaters in the Rocky Mountain front, natural flows in the Milk River are estimated to have ranged from as high as 35,000 cubic feet per second (cfs) during spring runoff to as low as 5 cfs during late summer and early fall of a dry year (USGS Water Resources Investigations Report 1986).

The Milk River basin is now home to four Indian reservations and numerous Indian allotments. The basin is also the site of the dispute that led to the *Winters* Doctrine — the recognition by the United States Supreme Court in 1908 of Indian reserved water rights (*Winters v. United States* 1908). More recently in the basin's history, a national park and several national wildlife refuges have been established, and bull trout, a listed species under the Endangered Species Act, have been found in its upper tributaries. The basin is the recipient of one of the earliest reclamation projects developed by the federal government: the Milk River Project.

The current configuration of the Milk River Project includes an interbasin diversion of water from a reservoir on the St. Mary River to the Milk River. The Project serves approximately 100,000 acres in seven irrigation districts located both upstream of and downstream of the Fort Belknap Reservation. In addition to the water contracted to the Districts, the Bureau of Reclamation (BOR) has individual contracts with irrigators for approximately 10,000 acres (RWRCC Staff Report 2002). Pursuant to reclamation law, the BOR followed state water law in obtaining water rights for the Milk River Project.

As part of its state-wide general stream adjudication in 1979, the State of Montana launched a new program for the resolution of reserved water rights through negotiation (Mont. Code Ann. § 85-2-701 to 708), and identified the Milk River basin as its highest priority (Mont. Code Ann. § 85-2-321(2)). In 1997, after years of data collection, negotiations began in earnest among the State, the Gros Ventre and Assiniboine Tribes of the Fort Belknap Reservation, and the United States. Among the problems facing the parties to the negotiation were: (1) No decree had yet been issued on the Milk River and claims filed by the BOR merely identified the place of use to be generally within the boundaries of the project. To understand and assure a water supply for these rights, the parties would need to understand them. (2) Analysis of alternative settlement solutions would require a thorough understanding of both the water supply and demand. (3) Implementation of a final decree that included settlement of tribal water rights would mean enforcement across state and tribal jurisdictional boundaries. Trust in multi-jurisdictional enforcement requires transparency – i.e. ability to verify water use throughout the basin (Greiman 2002).

The approach to analysis of alternative settlement solutions (2 above) will be discussed under the next section on development of a model. Defining water rights and developing a management and enforcement tool that facilitates verification of water use (1 and 3 above) were addressed through development of a GIS database on all irrigation water use from the river and its reservoirs in the U.S. portion of the basin. The following paragraphs describe how this tool was developed and why it can be such a powerful tool for determining and recording water rights in an adjudication and for implementation of a decree.

A GIS database can best be described as map overlays. Each overlay contains information that can be related to all other information for that geographic point. Thus, an irrigation field can be displayed in map form and related to information on the location of headgates that serve that field, priority date of the associated water right or rights, and the name and contact information for the water right holder.

In the steps to develop a model as outlined above, assembling a database on water use falls into the conceptual model stage. Both technical data and experiential information from local water managers and irrigators are necessary to develop an accurate GIS database.

For the Milk River, accurate data on each irrigation water right were developed by relating three pieces of information: (1) location of historic areas of irrigation determined from air photos; (2) location of water right claims filed in the adjudication; and (3) location of filed claims verified by the local field office of the Montana Department of Natural Resources and Conservation through examination of airphotos and discussions with irrigators. Once this information could be displayed in map form, representatives of the Montana Reserved Water Rights Compact Commission (RWRCC) worked directly with irrigators and irrigation district offices to verify accuracy and add canal systems and turnouts (Greiman 2005).

The Milk River GIS database was developed for use in settlement, but may provide a powerful tool for the adjudication as well. First, by comparing historic use from air photos to filed claims in a user friendly format, the adjudication court is provided with a simple means to verify anecdotal information on historic water use. Second, recording a decree in a GIS database rather than abstract form would increase the accuracy and ability to use a decree resulting from adjudication. The location of the diversion point and place of use of a water right claim in Montana are filed in terms of its legal land description (Mont. Code Ann. § 85-2-224(1)(d) – i.e. township, section to the nearest ¼ ¼ section and range. With this information, a point of diversion is only located to the nearest 40 acres. The rectangular description may not resemble the true shape of a field and it may be difficult to accurately identify overlapping claims.

In addition to providing a tool for use in verifying and recording water rights in an adjudication, a GIS database that reflects the final decree becomes a tool for management and enforcement. Complicating enforcement in the Milk River basin is the fact that one specific field may be associated with overlapping water rights that include a right to Project district water, a right to Project direct contract water, and a direct flow right pursuant to an individual state appropriative right (In addition to the 110,000 acres irrigated with Project water, approximately 35,000 acres are irrigated with claimed and unclaimed direct flow rights (Greiman 2005)). The GIS database is intended to reduce the complexity of accounting for water use under different water rights on the same land, and to facilitate the practical problem of deciding who gets what water and when. Once the groundwork had been laid for development of the Milk River GIS database, the BOR provided hardware, and staff for the RWRCC trained irrigation districts both on and off the Reservation to use and update the database. By linking entities in state and tribal jurisdictions to a common database, the state and BOR provided the basin with a tool for reporting water use across jurisdictional boundaries. Depending on the level of trust, an additional tool might be provided by adding links to telemetered turnouts for real-time recording of diversions (Greiman 2002). For management purposes, additional data sets such as precipitation, soil moisture and crop type may be added and updated on a daily or weekly basis to allow more efficient use of water. The database may also be used to facilitate accurate accounting and recording of assessments (Greiman 2002).

The relation of all the available data on the water resource, its use to a relevant geographic location, as well as the display in map form, provides a user -friendly tool for managers and for verification. However, it is also an excellent means to assure that the true nature of the legal right to water will not be lost in any discussion concerning its use or re-allocation. Although certainly considered a property right, a water right is a unique form of property in that the right is limited to its use. The physical thing itself is shared with many others holding use rights and, in most states, is also considered a public resource (see e.g. Article IX of the Montana Constitution, Article XV of the Idaho Constitution). A geographically-based database that shows a water right in relation to both its source and all other rights to use water from the same source facilitates the consideration of the interrelated nature of rights, both public and private, in decision making.

In addition, the GIS database for the Milk River provided far more detailed data on water use for input to a hydrologic model used in settlement than would have been available otherwise (Greiman 2005). Irrigation water rights in Montana are decreed on the basis of diversion rate and period of use corresponding to the irrigation season. No irrigation water right is exercised 24-7 throughout the season. In addition, diversion demand varies inversely with precipitation during the growing season. Furthermore, exercise of overlapping (or supplemental) water rights depends on availability of water rights for the same field from other sources in any year. Finally, depending on the efficiency of use, some of the water diverted returns to the river. Thus, diversion is a subset of right, and consumption is a subset of diversion. As a result, calculation of diversion, use, and return flow for input to a model is not a simple matter of entering decreed rights.

It should be noted that in the Milk River, the GIS database was merely used to tabulate data on water use for input to the model (Greiman 2005). More recent approaches look to an actual interface between the GIS database and the model, which may prove useful in the future (e.g. Matthews et al. 2001, Xu et al. 2001, and the Eastern Snake River Plain example discussed below).

The Predictive Tool: A Surface Water Model for the Milk River Montana

With a far more accurate idea of the existing water use that must be accounted for from the GIS database, the parties in the Milk River settlement talks developed a hydrologic model to test the impacts and water supply available from different solutions proposed to settle tribal water rights for the Fort Belknap Reservation on the Milk River. Keeping in mind the steps necessary to develop a hydrologic model, it was important for the parties to negotiate to determine at the outset the overall purpose of the model. Given the level of detailed data on water use from the GIS database, it would have been possible to develop a model for use as a daily/weekly management tool. Questions such as timing of releases from reservoirs, timing of opening and closing headgates, and impacts on surrounding water rights from transfer of a water right could then be addressed once settlement was complete. However, such a detailed model takes time. The need for a tool to evaluate proposed settlement solutions in the short term took precedence and a more general model was agreed to.

The BOR had developed code for surface water modeling referred to as HYDROSS. The BOR, tribal and state technical representatives then jointly developed the Milk River specific model using the HYDROSS code. Information on water demand (a subset of the water right in any given year and more likely to represent actual use) from the GIS database was combined with information on historic flows, precipitation, and storage, among other variables, to develop the model. The model was then used to evaluate the impacts of proposed off-stream reservoirs of various sizes, changes in existing reservoir management and size, and changes in diversions from the St. Mary River (RWRCC Staff 2002). Of importance to a discussion of the interface between decision making and science were two aspects of the development and use of the model that were key to its successful use.

First, the model was developed by joint technical teams representing the parties to the negotiation. This avoided the need to resolve differences between competing models through such uplifting means as commonly found at the interface between science and the law, such as character assassination of the opposing technical expert. It also left the discussion of technical modeling choices to the modelers, avoiding the second guessing of decisions by negotiators concerned with the outcome for their party. Leaving this to the modelers places a heavy burden on the scientists. The choices for input and approaches to modeling of a natural system are at least as variable as that system and the proposals on the table to resolve its allocation; thus reasonable scientists may disagree. A team charged with the task of agreeing on a single model must not only find a means to resolve differences, but take care to avoid coloring their positions with the desires of their client. Results in the Milk River suggest that technical representatives of the parties accomplished both of these requirements.

Second, the decision makers agreed not only to relinquish the technical work to the modelers, but to use the results of their efforts even when unfavorable to their position. This approach is essential to a successful water negotiation. By this statement, the author is not asserting that decisions must be based solely, or in some cases at all, on science. Merely that, to the extent an understanding of the hydrologic impacts of a proposed solution seem relevant to the decision, the analysis of those impacts by the joint technical team should be followed. In addition to providing a starting point for discussion, hydrologic analysis of proposed solutions can lend legitimacy to the solution chosen.

On the Milk River, this approach resulted in agreement to a new off-stream reservoir on the Fort Belknap Reservation (Montana Code Annotated §85-20-1001) – a solution that may not have seemed feasible without a thorough analysis of the water resource and competing uses. This is a major accomplishment in itself. However, had the parties taken the time to develop a more detailed model, they may have ended up with a tool for management and enforcement like the one discussed in the next section.

The Enforcement and Management Tool: A Ground Water Model for the Eastern Snake River Plain Aquifer

On April 19, 2005, Karl Dreher, director of the Idaho Department of Water Resources (IDWR), the entity charged with enforcing water rights in Idaho (Idaho Code §42-602), issued an order requiring curtailment of ground water pumping pursuant to water rights with a priority date of February 27, 1979, and later if no plan to provide mitigation water in the amount of 133,400 acre-feet to senior surface water users is developed (IDWR Order, April 19, 2005, as amended May 2, 2005). This unprecedented effort to enforce the seniority of surface water rights against junior ground water use required a thorough understanding of the water resource; in particular, the hydrologic connection between surface and ground water in the Eastern Snake River Plain (ESRP). The hydrologic setting of the ESRP, the development of a ground water model to analyze and quantify the impact of ground water pumping on surface water use, the legal setting, and the reliance of IDWR on the model to issue the Order are discussed in the following paragraphs. Although this enforcement action takes place prior to completion of the Snake River Basin Adjudication, it serves as an example of how a database and model developed in or as a result of adjudication could be used for enforcement.

The ESRP is a plain covering roughly 200 by 60 miles in southeastern Idaho underlain by thick basalt flows and interbedded sediments (Johnson, et al. 1998). The basalt layers and sediments host the Eastern Snake River Plain Aquifer, a designated sole source aquifer (Idaho Administrative Code 37.03.11.050). Ground water flow in the contact zones between basalt flows may be substantial. Discharge from the aquifer along these contact zones can amount to the majority of the flow of the Snake River below Milner Dam in summer (Johnson et al. 1998).

With an annual precipitation of only 8-14 inches, this rich agricultural region relies on irrigation. Under the doctrine of prior appropriation, surface water rights from the Snake River and its tributaries, including the many springs, developed before the now extensive development of the aquifer, take precedent. Interaction between surface and ground water is often highly complex. Some of the water spread over the surface of the land by precipitation and irrigation will seep into the ground water. Seepage will vary with the permeability of surface soils and geologic units, with rate of precipitation or application of water, and with the existing soil moisture content. Surface streams may lose water to, or gain water from ground water. Flow rates vary within an aquifer. Many streams lose in some stretches while gaining in others (Winter, et al. 1998). As a result of these and other variables, the impact of ground water use on surface water is not direct, immediate or one-to-one. Because of this complex interaction, scientists at the University of Idaho, Idaho Falls, Idaho Water Resources Research Institute (IWRRI), had begun developing a ground water model four years before its use by IDWR to issue the 2005 Order to aid in management of the aquifer and the development of plans to mitigate the impact of its use on surface water. Thus, the initial purpose of development of the model had little to do with the Order. The tool developed and the process used to develop it nevertheless served that purpose (Cosgrove 2005).

Similar to the surface water modeling process described for the Milk River, the IWRRI scientists faced problems in providing input to the model at an appropriate scale to allow the detailed analysis sought. Recharge to the aquifer is complex, coming from sources as diffuse as precipitation, irrigation and rivers. Again, the scientists turned to GIS, this time to provide input on recharge to the aquifer, which is referred to as "the recharge tool." Jim Oakleaf of the University of Wyoming developed the GIS component of the recharge tool. Dr. Donna Cosgrove of the University of Idaho then developed the computer code to link the GIS component to the ground water model (IWRRI and BOR 2003). The advantage to this approach of linking the GIS database to the model over the mere use of the GIS database to independently calculate input to the hydrologic model used in the Milk River example, is that modifications and updates to the database can immediately be used as input to the model (Greiman 2005). This makes the model far more useful as a management tool, because it can be modified with each change in water use or supply.

A code developed by the USGS for ground water models – MODFLOW – was used to develop the Eastern Snake River Plain Aquifer model. MODFLOW can include a dynamic river representation that allows the modelers to address the surface water interaction at issue in the ESRP. IWRRI scientists, in consultation with the Idaho Department of Water Resources (IDWR), chose a unique process to develop the model that may prove useful as challenges to the 2005 Order are heard in court. The model input was developed in open meetings with each major group interested in the model represented by hydrologists. Final decisions on areas of disagreement were made by the IWRRI scientists. This open and collaborative approach should eliminate concerns (or at least legitimate concerns) with bias. According to Dr. Cosgrove, while it would be difficult to bias the model itself, the questions posed for analysis with the model could readily be biased if only one viewpoint provided input. In addition, the experiential input and differing focuses of the many participants improved the model (Cosgrove 2005). This type of process costs time in the initial development of a model, but the savings resulting from education, buy-in, and model accuracy should more than pay off in the end.

Idaho follows the doctrine of prior appropriation for both surface and ground water (Idaho Constitution Art. XV §3, Idaho Code §42-106). But until now, IDWR had not enforced water rights as if surface and ground water were one resource, referred to as "conjunctive management." In 1994, the Idaho Supreme Court ruled that IDWR must enforce a call by senior surface water users against junior ground water pumpers (*Musser v. Higginson* 1994). That same year, IDWR promulgated the Conjunctive Management Rules to provide uniform guidelines and procedures for enforcing a surface-ground water call. In addition to the complexity of the surface to ground water connection, among the pronouncements in Idaho law that IDWR dealt with are: (1) Idaho law states that the doctrine of prior appropriation, while applicable to ground water, "shall not block full economic development of underground water resources" (Idaho Code §42-226), (2) the Idaho Supreme Court has repeatedly declared that the public policy of the state prohibits waste in the use of water (*Glenn Dale Ranches, Inc. v. Shaub* 1972); and (3) Idaho law prevents a futile call, defined in the conjunctive management rules as a call that, "for physical and hydrologic reasons, cannot be satisfied within a reasonable time of the call by immediately curtailing diversions under junior-priority ground water rights or that would result in waste of the water resource" (Idaho Administrative Code 37.03.11.010.08).

The Conjunctive Management Rules walk the line between prior appropriation and the legal and real need for efficient use of water in an arid region by basing enforcement of a call on a finding by IDWR of material injury (Idaho Administrative Code 37.03.11.010.07). IDWR may consider a number of variables in determining if material injury exists including factors that reflect water supply, investment, efficiency, availability of reasonable alternative means of diversion, and the use of meters (Idaho Administrative Code 37.03.11.042.01).

When, after five years of drought and corresponding increases in ground water pumping and surface water demand, surface water users sought enforcement, IDWR turned to the IWRRI model for the answer to whether ground water pumping actually resulted in material injury to the senior surface water users. The model predicted that under water supply conditions anticipated for 2005, ground water pumping with a water right of February 27, 1979, or later would impact those surface water right holders asserting the call by 133,400 acre-feet (IDWR Order, April 19, 2005, as amended May 2, 2005). Under the Conjunctive Management Rules, ground water pumpers may submit mitigation plans such as purchase of storage right for transfer to senior water users rather than face curtailment (Idaho Administrative Code 37.03.11.040.01b). As of the writing of this article, the deadline had not run for filing of petitions for a hearing before the Director contesting the Order and no mitigation plans had been filed.

Conclusion

Increasing population and prosperity in the arid West can only be served with increasingly efficient management of our water resources. Adjudication should not proceed with the assumption that a decree defines the playing field for all time. It is but the starting point. As new demands for water arise or values change, use and transfer must take place with an ever-decreasing margin for error in assessing the impact on others who share the resource. The tools exist to assure that the outcome of an adjudication provides the means to analyze these types of determinations. Because, after all, understanding the water resource is relevant to its allocation.

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